

A POLYGYNOUS COLONY OF *VESPULA PENNSYLVANICA* (SAUSSURE) (HYMENOPTERA: VESPIDAE)^{1,2}

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ABSTRACT: In 1979 a colony of *Vespula pensylvanica* (Saussure) with three functional queens was collected at Prosser, Washington. This is the first polygynous colony of yellowjackets recorded from a cool temperate area.

All yellowjacket colonies are initiated by a single inseminated queen, the only member of the colony to survive the winter. During the first warm days of spring (April – June) the queens emerge from hibernation (reproductive diapause) and search for nest sites. Once the site has been selected, the queen initiates the construction of a small nest of up to 45 cells in which she lays her eggs. At this time, the queen forages for construction materials and for arthropod prey to feed the larvae. However, once the first five to seven workers emerge, they assume all the duties of the colony, and the queen rarely leaves the nest again. Her primary responsibility from this point onward is the laying of eggs. The nest is constantly expanded and successive broods of workers are reared. Later in the season (August – September) the workers build larger reproductive cells in which both males and queens are produced. The colony enters a declining phase shortly thereafter, when workers pull larvae from the comb and feed them to other larvae or discard them. After emergence the new queens and males leave the nest and mate. The males eventually die while the inseminated queens hibernate. The next spring the cycle is repeated. Thus, typical yellowjacket colonies are monogynous and annual. Attempts by other queens to enter the nest usually result in fierce fighting between the intruder and the resident queen and/or the workers (Matthews and Matthews 1979).

However, there are reports of atypical, perennial colonies of yellowjackets containing numerous queens. While vespines (hornets and yellowjackets) are essentially north temperate in distribution, two species, *Vespula germanica* (Fab.) (Edwards 1976) and *V. vulgaris* (L.) (Spradbery 1973a, Richards 1978) have been introduced into south temperate regions.

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Wherever *V. germanica* occurs, colonies seem to have a propensity for becoming perennial in the warmer temperate or subtropical regions. For example, perennial colonies of this species occur in New Zealand (Thomas 1960), Tasmania (Spradbery 1973b), Algeria and Morocco (Viillaume *et al.* 1969) and Chile (Jeanne 1980). Perennial colonies are usually large, and one nest was estimated to weigh 1,000 pounds (Spradbery 1973a). There are also reports of several other species of yellowjackets (primarily in the *V. vulgaris* (L.) species group) establishing perennial colonies in the warmer areas of their temperate distribution. Huge perennial colonies of *V. squamosa* (Drury) have been recorded from Florida (Tissot and Robinson 1954, Akre *et al.* 1981), and a single perennial colony of *V. vulgaris*, having 21 comb levels and 22 functional queens, was discovered in California (Duncan 1939). A perennial colony of *V. pensylvanica* (Saussure) has been reported from Hawaii (Nakahara 1980) and in addition, there is a report of a possible perennial colony of *V. pensylvanica* in Vancouver, British Columbia (Spencer 1960). However, no perennial colonies have been reported in those species which have relatively small colonies (*Dolichovespula* spp.) and nests with only one worker comb (*V. rufa* (L.) species group).

Since 1971 more than 450 colonies of *Vespula* species have been collected from northern Idaho and Washington. Slightly more than half these colonies were *V. pensylvanica* and 10% were *V. vulgaris*. With one exception, these colonies contained only one functional queen. However, a large colony of *V. pensylvanica* with multiple queens was collected 23 October 1979 and is the basis of this report.

Collection Data

The colony was located in Benton County, Washington 4 miles NE of Prosser. On 22 October when the colony was discovered, workers were still actively foraging. The colony was killed with carbon disulfide after dark. The nest and its contents were excavated the next day and immediately frozen for later analysis.

The subterranean nest was located on a south facing slope protected from winds by a large bank. This area is favored as an overwintering site for honey bee colonies since it is one of the lowest (590 ft. elevation) areas in the vicinity and is situated so the area is basked in sunlight early in the spring.

The bank where the nest was located is extremely rocky, and the nest was irregularly constructed in spaces where the yellowjackets had been able to excavate soil from among the rocks. Although external dimensions do not give a reliable indication of nest size, the nest was approximately 42 cm long x 22 cm wide x 15 cm deep.

Nest and Colony Analysis

The nest consisted of 7 comb levels with 8 combs. The first (uppermost) two combs consisted entirely of worker cells, the next two a combination of worker cells and queen cells, and the final four were entirely queen cells. Thus, this colony had a normal transition from worker to reproductive cells with no reversal to worker cell production. Thirty-six percent of the cells were queen cells and the worker/queen cell ratio was 1.77. This is well within the normal range of these parameters for *V. pensylvanica* colonies (Roush and Akre 1978). There was a total of 14,300 cells.

The colony was obviously declining as 5,391 cells were empty and more than 200 had multiple eggs (2-4). In addition, there were 1,081 new queens, 1084 males, but only 510 workers.

Besides the 1,081 new queens there were three queens that appeared old as evidenced by "age spots" (brownish discoloration of gastral terga II and III) and the frayed condition of the wings. The wings of one of these queens were extremely frayed, the other two to a lesser extent. Dissections showed that all had fully developed ovaries packing the entire gaster (Fig. 1), and

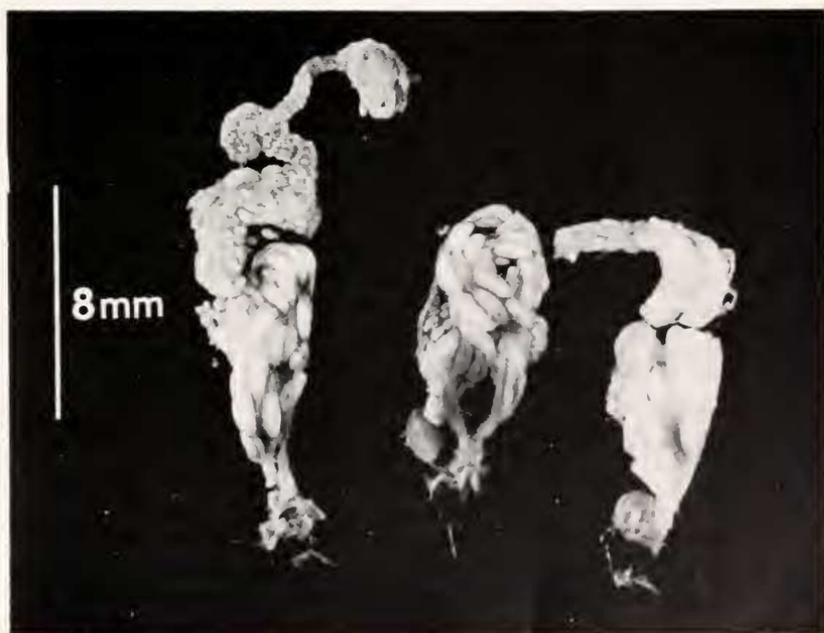


Fig. 1. Ovaries of the three functional queens. The ovary of the probable foundress queen, as indicated by her extremely frayed wings, is on the left.

spermathecae filled with sperm. All three were functional (egg laying) queens.

Discussion

Although it is not known if the colony had been there the previous year, this is considered unlikely based on size. Most perennial colonies have more individuals and much larger nests (e.g. a perennial *V. squamosa* nest of 120,000 cells; Akre *et al.* 1981). However, 1979 had a warm, dry spring (Akre and Reed, 1981), and the colony could have been initiated very early, perhaps in March. In addition, the area where the colony was located is probably one of the warmest in the Columbia Basin, an area with one of the longest growing seasons in Washington. During 1979 hot, dry weather continued through October and this gave the colony an extremely long season.

This is the largest nest of *V. pensylvanica* recorded from Washington. The largest nest collected previously contained 12,316 cells, but most analyzed colonies had nests of 4,000 to 10,000 cells (Akre *et al.*, 1981). However, at slightly more than 14,000 cells, this nest was still considerably smaller than nests from a few nonperennial colonies of *V. vulgairs* reported from Europe. The largest nest collected in Germany had 21,692 cells (Kemper 1961).

Since all three functional queens had age spots and frayed wings, it is highly unlikely that any were new queens from this or a nearby colony that had subsequently developed ovaries. *V. pensylvanica* queens usually develop these spots only after they are several months old and have been actively laying eggs, typically by late August or early September. Non-functional queens never develop these discolorations no matter how old they become.

Many new queens do not initiate a nest of their own in the spring and, in Washington, are still flying as late as August. Perhaps two of these queens joined the colony. *V. pensylvanica* queens frequently attempt to usurp control of colonies of conspecifics and those of *V. vulgaris* (Akre *et al.* 1977, unpublished data). If they attempted to join the colony late in the year when queen control was low and workers had begun to develop their ovaries, resistance to their entry may have been minimal. Or perhaps a situation developed similar to that which frequently exists between the social parasite *Dolichovespula arctica* (Rohwer), and its host, *D. arenaria* (Fab.), in which a period of coexistence occurs between the host queen and the parasite female (Greene *et al.* 1978). During seasons with intense intraspecific queen competition an intruding queen may coexist with the foundress queen. An example of coexistence early in the nesting season was a *V. vulgaris* colony which was collected and killed on 22 July 1980. It

contained two queens but only 1 worker comb of *ca.* 100 cells.

The development of a large, polygynous colony of *V. pensylvanica* in the Columbia Basin of Washington, with at least a potential for becoming perennial, indicates that areas such as the Columbia Basin, an island of warmth in the northern tier, could provide a suitable habitat for increasing colony longevity and thus enhancing the possibility of perennial colonies.

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